

**AN EXAMINATION OF THE ISSUES AND FEASIBILITY
OF CONDUCTING SURVEYS OF ABANDONED MINES FOR BATS**

A Report to:

**The Montana Natural Heritage Program
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Submitted by:

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ABSTRACT

The Montana Natural Heritage Program (MTNHP) is surveying inactive and abandoned mines on Bureau of Land Management Lands in southwest Montana for bats. One aspect of the study involves internal surveys of mines. Because of the inherent hazards of working in and around abandoned mines there are a number of safety and liability concerns associated with this work. Risks must be minimized while conducting internal surveys. This report identifies a number of measures to minimize risks. An MSHA certified underground safety training and current first aid and CPR certification are required for any MTNHP (or TNC) employees, contractors and volunteers who plan on entering abandoned mines. Personnel entering mines must be trained in the use of a variety of safety equipment. Robin McCulloch, of the Montana Bureau of Mines and Geology, has agreed to offer a 1-day MSHA certified safety training on April 7, 1998 at the Montana Tech campus. This training will be tailored to the entry of inactive and abandoned mines. Also, as recommended by numerous authorities on the subject, vertical climbing or rappelling into mine shafts is to be avoided. Recommended safety equipment, vendors and prices are summarized in this report. Much of the safety equipment is expensive. There may be opportunities to share the cost of this equipment with interested parties. Also, some equipment may be rented from vendors or possibly purchased from mines that are closing down.

A tentative sequence for mine site assessment was identified and consisted of three components: 1) Hazard Assessment, 2) Biological Assessment and 3) Geological Assessment. Those personnel currently experienced in mine entry and hazards would constitute a "hazard analysis team." This team would be the first to enter a given mine to conduct a hazard assessment. The assessment would identify the type and location of any hazards, and determine if subsequent biological and geological surveys are feasible and warranted. Subsequent biological surveys would be conducted by trained personnel, following a briefing on the layout of the mine and hazards.

Because of specialized training, experience, and equipment required to conduct the internal surveys, this work will be expensive and time consuming. Due to budget constraints, internal survey work will limit the amount of external surveys that can be conducted. I recommend that MTNHP personnel visit with representatives from the funding agency (USGS) to prioritize the remaining work on this project and determine how much, if any, internal survey work should be conducted relative to external surveys.

There have been discussions with the funding agency (USGS) regarding the possible use of temperature and humidity data loggers for monitoring the internal environment of mines. Information was obtained on the cost and availability of data loggers. ONSET Computer Corporation recommends waiting until they have a weatherproof dual-channel unit that will record both temperature and humidity. The available single-channel humidity data loggers are not moisture resistant and prolonged exposure in a mine could damage the unit. MTNHP should discuss the desired use of data loggers with USGS in order to decide if the investment is worth making.

AN EXAMINATION OF THE ISSUES AND FEASIBILITY OF CONDUCTING SURVEYS OF ABANDONED MINES FOR BATS

Background

The Montana Natural Heritage Program, with funding from the USGS Biological Resources Division, is conducting a survey of abandoned mines on BLM lands in southwest Montana for bat use. The objective of this study is to identify mines used by bats and evaluate a variety of external and internal variables that would enhance predictive capabilities for locating active roosts and hibernacula. The proposed work calls for internal surveys of selected mines, which would include searching for evidence of bat use (e.g., guano) and hibernating bats, recording temperature, humidity and air flow at predetermined distances into a mine, and recording information on mine characteristics (e.g., length/depth, configuration). Additionally, USGS has expressed an interest in using data loggers to record and monitor temperature and humidity fluctuations over several months of the summer and/or winter seasons in selected mines with bats and without bats.

This report identifies and discusses issues related to the entry of abandoned mines (e.g., liability, safety, trespass), lists the equipment and training needs for conducting internal surveys and identifies a tentative protocol for conducting the surveys. Also, an evaluation of cost and considerations for the use of temperature and humidity data loggers is presented. The material provided on procedures and equipment is derived primarily from a published paper by J.S. Altenbach (1995)¹ and a meeting held February 26th at the Montana State Library (see Table 1 for a list of participants). Also, additional information was obtained through discussions with TNC legal council, Bat Conservation International, Colorado Division of Wildlife, Montana Department of Environmental Quality Mine Waste Cleanup Bureau, mine safety professionals (state and private), Forest Service and BLM geologists and equipment vendors.

Liability Issues

The entry of abandoned mines is inherently hazardous. This situation raised the question as to who is legally liable for injuries sustained while conducting this work. The Colorado Division of Wildlife uses a detailed safety and awareness checklist and document limiting liability of the state of Colorado for volunteers conducting external mine surveys. The Nature Conservancy's current liability waiver on contract agreements and volunteer forms may be inadequate for situations involving the entry of abandoned mines.

TNC legal council explored the issue of liability for TNC employees and non-employees injured while conducting internal mine surveys. Susan Lauscher (pers. Comm.) of TNC provided the following conclusions and guidelines.

1. There are no clear answers. Any liability issue will ultimately be settled in court.
2. TNC will be liable for any TNC employee injured or killed while conducting underground mine surveys.

¹ Altenbach, J.S. 1995. Entering mines to survey bats effectively and safely. Pp. 57-61 in B.R. Riddle (ed.). Inactive mines as bat habitat: guidelines for research, survey, monitoring and mine management in Nevada. Biological Resources Research Center, University of Nevada, Reno. 148 pp.

3. TNC legal staff will need to craft a detailed and very concise liability waiver statement for volunteers and contractors. With such a waiver there is still no guarantee that TNC will be protected from a legal action.
4. RISKS must be minimized.
 - a. No one goes underground without appropriate training in underground mine safety and instruction on the proper use of safety equipment.
 - b. No rappelling into mine shafts by TNC personnel or by TNC contractors and volunteers.

Bat Conservation International (BCI) and USGS Biological Resources Division (BRD) strongly recommended that participants in this work attend a certified Mining Safety and Health Administration (MSHA) training. (However, it should be noted that MSHA regulations only apply to active mines.) Additionally, BCI recommended subsequent apprenticeship with people experienced in entering underground inactive mines. Vertical climbing or rappelling into mine shafts is strongly advised against by experienced BCI personnel, Dr. J.S. Altenbach, TNC, BRD, and Robin McCulloch (MT Bureau of Mines and Geology). In western states where mine shafts are entered to conduct bat surveys, a boom and winch are used to mechanically lower an individual, with three gas detectors and a two-way communication device, into a shaft.

Safety Issues and Equipment

Discussions at the February 26th meeting identified a variety of safety issues and equipment needs. Table 1 lists safety equipment and other tools for conducting internal surveys and data collection.

Robin McCulloch (MT Bureau of Mines and Geology) identified **predictability** of what's inside a mine as being a key factor to safe entry. Knowledge of the local geology, mineralogy, and production history can provide information to many of the structural hazards and any gases that may be encountered. Also, mine maps, if available, are invaluable. Robin has access to 3,000 to 4,000 mine maps at the Montana Bureau of Mines and Geology in Butte. Robin McCulloch's secretary can research mine maps for this project. *[After reviewing 250⁺ files on inactive/abandoned mines at the Mine Waste Cleanup Bureau in Helena, I've found only one map of underground workings.]* There are Montana Bureau of Mines and USGS publications² available that describe the geology and ore deposits in most, if not all, of the mining districts in our study area.

Robin McCulloch suggested that ½ day might be required to evaluate just what you want to do inside a mine with substantial internal structure. Also, Robin indicated that approximately 900 abandoned mines occur on BLM lands in Montana, of which ca. 10% have significant workings and 2% may have substantial vertical workings.

Structural stability: Diamond Hill Mine Rescue Team (Townsend, MT) and other mine safety personnel suggested the use of a poke stick (or scaling bar) to test for loose rock. Robin McCulloch expressed concern on the use of such a device, in that accidental or intentional dislogging of loose

² Example of MT Bureau of Mines and Geology publications housed at the MT State Library in Helena include: Sahinen, U.M. 1939. Geology and ore deposits of the Rochester and adjacent mining districts, Madison County, MT; Shenon, P.J. Geology and ore deposits of Bannack and Argenta, MT; Willis, J.M. 1961. Geology and ore deposits of the southern Tidal Wave mining district, Madison County, MT.

rock could create a disequilibrium that could lead to a larger cave-in. A poke stick should be used with caution and only after adequate training on the proper use of the stick.

Explosives: There is a possibility of encountering old explosives. Robin McCulloch identified old explosives as primarily an issue of recognition. If explosives are observed, they are to be avoided – **Do not touch!**

Rotten Mine Timbers: Rotten timbers were identified as a primary risk item. Timbers may be rotten, yet look brand new!

Fungus and Molds: People with allergies may be adversely affected by fungus and molds (e.g., asthma).

Gases: Knowing the mineralogy of an area will assist in identifying the potential for encountering various gases. Gas detectors will be necessary for underground work. Continuous monitoring (i.e., electronic) detectors are the best and it is advisable to get ones that allow the O₂ level to be calibrated for elevation. Hydrogen sulfide gas (H₂S) could be encountered in areas with sulfide minerals. In addition to O₂ and CO detectors, an H₂S detector would be useful. Low Explosive Level (LEL) detection was strongly suggested by others.

Robin advised that the time of year is an important factor to consider with regards to encountering gases in mines. Differences between internal and external temperatures result in passage of air through a mine. At times of the year when differences between internal and external temperatures are minimal (e.g., April/May), there may be no, or limited, air movement, resulting in the accumulation of toxic gases.

Robin suggested that radon exposure might be a hazard in some areas, such as the Boulder batholith. As a group, we agreed that radon dosimeters would be useful safety items for each individual entering a mine.

Oxygen-generating self-rescue devices are recommended equipment for underground work. Robin McCulloch did not feel that self-rescue devices were necessary and that gas detectors would provide adequate protection. In Robin's many years of experience working in inactive and abandoned mines, he has encountered bad air in only three places. However, advice provided by Diamond Hill Mine Rescue Team, Montana Mining Association Safety Coordinator, MT State Mine Inspector, BCI, and Altenbach (1995) strongly recommend that each person going underground carry an oxygen-generating self-rescue device. Meeting participants agreed that self-rescue devices are necessary. Electronic gas detectors and self-rescue devices are quite expensive and there may be opportunities to pick up equipment at a discount from mines that are shutting down. Alternatively, some mine equipment suppliers may rent such equipment.

Communications: In the event of an accident, the ability to call for assistance is important. Access to a cellular phone or radio is recommended. A communication link between people underground and someone stationed at the entrance is desirable, but impractical due to problems in signal transmission underground.

Underground Safety Training: MSHA provides a certified 40-hour underground mine safety training. This training includes 8 hours of first aid and CPR. The other 30 hours deal primarily with

underground safety as it relates to the actual work that miners perform - which, for the most part, is not relevant to us. The MSHA training does include some treatment of safety within inactive areas of operating mines. The MSHA training provides practice in the use of gas detectors, self-rescue devices and other safety equipment. Bat Conservation International, mine safety professionals, and Altenbach (1995) recommend a certified MSHA training for underground work.

Robin McCulloch has experience teaching certified MSHA training courses and has offered to provide an abbreviated training tailored to working in inactive and abandoned mines. This training will result in safety certification for participants. Dave Kampwerth may be able to provide an 8-hour first aid and CPR training prior to or immediately following the underground safety training for those who either have not had first aid/CPR training or their certification is expired. **Certified underground safety training and current certification in first aid/CPR will be mandatory for working underground.**

Entry Team: Bat Conservation International and Colorado Division of Wildlife recommend a minimum of three people for a mine entry team - one person is stationed at the entrance and two go in. Robin McCulloch suggested that two people would be sufficient for single-level entry and three people would be needed for more complex sites. Dave Kampwerth expressed BLM's position, recommending four people, three inside and one at the entrance. In the event of an injury, one person can remain with the injured person, while the other seeks help. We agreed that for the underground bat surveys there would be four team members. First aid and underground safety training is required of all members entering a mine, while the person stationed at the mine portal is required to have a minimum of first aid and CPR certification.

Of the participants at the February 26th meeting, Robin McCulloch, John McKay, and Bill Weatherly are the only people currently qualified and experienced in entering inactive and abandoned mines.

Mineral Assessments and Mine Mapping: Robin McCulloch expressed an interest in seeing multiple inventories including minerals, future safety and biological components. BLM geologists, John McKay and Bill Weatherly, concurred with the need for mineral assessments. Also, there may be some federal money available for geoassessments. Two to three days would be required to conduct a thorough geoassessment of a large and complex mine. Smaller mines may be assessed in a day or less. Robin may already have conducted internal assessments of mines on the study area.

Entry Protocol

A tentative sequence for mine site assessment was discussed and consisted of three components: 1) Hazard Assessment, 2) Biological Assessment and 3) Geological Assessment. Those personnel currently experienced in mine entry and hazards would constitute a "hazard analysis team." This team would be the first to enter a given mine to conduct a hazard assessment. The assessment would identify the type and location of any hazards, and determine if subsequent biological and geological surveys are feasible and warranted. Subsequent biological surveys would be conducted by trained personnel, following a briefing on the layout of the mine and hazards. Since internal conditions may change over time, subsequent entry into a mine would have to occur within weeks of the hazard assessment, not months. To enter a mine five months later would require a safety review. This would likely be the case when retrieving data loggers that had been inside a mine for several months, or conducting winter surveys.

Initially, biologists would probably enter mines with at least one member of the hazard analysis team. As experience is gained, or for sites deemed safe, a biological assessment team may enter mines independently, but only after the initial hazard assessment and within a short time of the initial assessment.

Personnel Cost: Currently, Dave Kampwerth, Robin McCulloch, John McKay, and Bill Weatherly have indicated that this work is within the scope of their work duties and their time involvement will be covered by their respective agencies. If a problem arises with respect to time involvement, Dave Kampwerth, John McKay and Bill Weatherly indicated that they would volunteer time on weekends. Currently, the only personnel time to be billed against this project for mine entry will be MTNHP employees and any contractors. Also, expenses would need to be covered for any volunteers.

Trespass

This project is to focus on surveying mines on BLM lands. However, many sites are a mix of unpatented and patented claims and there is difficulty in identifying property boundaries on the ground or on a map. Vic Anderson, with the MT Dept. of Environmental Quality Mine Waste Cleanup Bureau suggested that the only way one can be certain of ownership in areas of mixed ownership is to have a surveyor locate property boundaries. Robin McCulloch also indicated that in some instances a mine claim might have a portal on one property, while workings farther underground may be on a different ownership.

I had explored the issue of legal trespass on patented and unpatented claims. Geologists with the Butte District of the BLM provided an opinion regarding the entry of unpatented claims on BLM lands. Conducting internal bat surveys on unpatented claims would not be considered trespassing, since minerals are being removed. However, if a mine portal on an unpatented claim has a locked gate, then permission from the claim holder would be required. For patented claims on private property, written permission would be required from the landowner or claim-holder. If portals (on unpatented or patented claims) have locked gates or grating installed by the state of Montana, it would be necessary to contact the claim-holder in order to obtain a key. According to Vic Anderson (MTDEQ), in the case of unpatented claims, keys were given to the claim-holder rather than the managing agency. The Dillon Resource Area or Butte District BLM offices should have record of current claim-holders.

Participants at the February 26th meeting agreed that the best approach to avoiding conflicts over trespass would be to **always contact the claim holder/landowner prior to conducting any internal surveys**. For any mixed ownership or clearly privately owned lands, **formal written permission** would probably be required by TNC and USGS BRD.

Site Selection for Entry

To fulfil the objectives of this study, it will be important to gather data on internal variables (temperature, humidity, airflow, complexity, etc.) at mines not used by bats as well as mines used by bats. Based upon fieldwork conducted last year, the following mines were identified as having potential for internal entry. However, those of us who conducted the external bat surveys were not trained in hazard assessment and likely were conservative in our identification of suitable sites.

1. Black Ace (BLM)
2. Clipper Mine (Mixed BLM-Private or Private)
3. Empire or American Flag (Mixed BLM-Private)

4. Hendricks Mine (State)
5. Huron-Cottontail (Mixed BLM-Private)
6. Unnamed adit near Mineral Hill Mine on Headwaters R.A.
7. Mountain View Mine (Garnet Resource Area)
8. Phosphate Mines near Melrose (surface caves in vicinity)
9. Short Shift Mine
10. Tidal Wave Mine incline
11. Vicinity of the Watseca Mine (most likely Private)
12. Mountain Cliff Mine

Data Needs

Surveys of internal mines consist of searching for evidence of bat use (i.e., guano, insect parts) and cold-season surveys would also include searches for hibernating bats. If bats are found, a quick estimate of the numbers, species, roosting characteristics and substrate should be documented. Data should be recorded on the following variables:

- ◆ Temperature and Humidity – recorded at pre-determined intervals within a mine
- ◆ Air Flow
- ◆ Length of passage
- ◆ Substrate type and characteristics
- ◆ Mine complexity
- ◆ Connections to other openings

Data Loggers

I explored the cost of obtaining data loggers for recording internal temperature and humidity regimes over extended periods of time during selected seasons. I contacted Ray Bartlett of ONSET Computer Corporation regarding their lines of HOBO and StowAway data loggers.

Sometime this summer (1998), ONSET will be offering a dual channel weatherproof temperature and humidity data logger. Ray expects the unit price to be somewhere between \$100 and \$200. Currently, they have a dual-channel unit for \$85 that is not waterproof.

Single-channel humidity data loggers range from \$149 - \$266. Such a unit could be suspended inside an upside-down plastic funnel. The hole at the top of the funnel would allow warmer air to escape and minimize the moisture condensation, which could damage the unit. Such a setup might be feasible for our bat project. However, Ray pointed out that if you can't check the units frequently, then he would recommend waiting for the new waterproof units.

Single-channel temperature data loggers are available for \$49 plus \$20 for the waterproof case. The computer software required for data logger setup, data retrieval and data analysis cost \$59.

Conclusions

The entry of abandoned mines is hazardous work, but can be conducted safely with proper equipment and training and following previously agreed-upon procedures. Robin McCulloch of the Montana Bureau of Mines has agreed to put on a certified underground safety training session (1 day) free of charge on April 7, 1998. Dave Kampwerth may be able to put on an 8-hour first aid and CPR training for a minimal fee, if there are enough participants. The underground training would probably be most

effective if limited to 10 people. An MSHA 40-hour underground safety training may be available at various times of the year at some mines in Montana. A procedure consisting of a preliminary internal hazard assessment prior to conducting internal surveys for bats was identified. Re-entry of a mine several months later to retrieve data loggers or conduct searches for hibernating bats would likely require a review of the safety of a given mine.

Safety equipment costs are quite expensive. There may be opportunities to obtain used equipment from mines that have closed or are in the process of closing down (e.g., the Mineral Hill Mine at Jardine, MT). Some safety equipment suppliers rent equipment (see accompanying catalogs). Since various government agencies are interested in having mines surveyed underground for bat use, there may be opportunities to share the cost on some equipment. I was unable to find inexpensive radon dosimeter badges. The electronic radon dosimeters are quite expensive. Sam Martinez thought that he might have a catalog listing some of the less expensive units.

Data loggers are also somewhat expensive. Also, the use of data loggers requires a second trip into a mine for retrieval of the unit. The need to revisit a mine carries with it an additional cost. If data loggers are used, I recommend following the suggestions of Ray Bartlett, ONSET Sales Representative, to wait until ONSET makes available a weatherproof dual-channel unit (temperature and humidity). The number of data loggers to be purchased will depend on several factors, including: the budget, how many sites can be reasonably sampled, and if simultaneous sampling of various mines is desired. The objectives of the data collection should be clearly defined prior to investing in a number of data loggers.

For the current project, MTNHP will need to evaluate the remaining budget and costs for equipment, personnel, travel, etc. to determine how much, if any, internal survey work should be conducted relative to external surveys. Also, some personnel were available to conduct external survey work only on weekends. It is highly inefficient for someone to expend the travel time for only 1.5 nights of external survey. The use of personnel for weekend surveys should be evaluated and a decision made to either minimize or eliminate weekend-only surveys.

Table 1. Participants at the February 26, 1998 meeting on bat surveys at abandoned mines, Montana Natural Heritage Program, Helena, MT.

Name	Organization	Address	City/State/Zip Code	Phone Number
Beer, Margaret	MT Natural Heritage Program	1515 East Sixth Ave.	Helena, MT 59620	(406) 444-3009
Brown, Michelle	University of Montana	5120 Huckleberry Rd.	Missoula, MT 59803	(406) 543-7900
Donaldson, Joe	MT Department of Labor, Safety Bureau, Mine Safety	P.O. Box 1728	Helena, MT 59624-1728	266-3501
Feigley, Pete	MT Natural Heritage Program	403 North Maple	Townsend, MT 59644	(406) 494-6401
Hendricks, Paul	MT Natural Heritage Program	909 Locust	Missoula, MT 59802	(406) 266-3094
Kampwerth, Dave	BLM, Dillon Resource Area	1005 Selway Drive	Dillon, MT 59725	(406) 543-0995
Martinez, Sam	MT Dept. Environmental Quality	1520 East Sixth Ave.	Helena, MT 59620	(406) 444-0917
McCulloch, Robin	MT Bureau of Mines and Geology	Montana Tech, 1300 West Park Street	Butte, MT 59701-8997	(406) 496-4171
McKay, John	BLM, Butte District	P.O. Box 3388	Butte, MT 59702-3388	(406) 494-5059
Weatherly, William	BLM, Headwaters Resource Area	P.O. Box 3388	Butte, MT 59702-3388	(406) 494-5059

Table 2. Recommended safety equipment for internal mine surveys and equipment for data collection.

(This list contains the minimum safety equipment recommend by J.S. Altenbach, Dept. Biol., Univ. New Mexico. Additional items were added based on discussions with the Mine Rescue Team at the Diamond Hill Mine at Townsend, MT, Ron Umschied of MT State Department of Labor, and participants at the February 26th meeting. Items in italics are listed by J.S. Altenbach (1995) as minimum safety equipment.)

EQUIPMENT	Number needed	Availability	Per Unit Cost*	Source of Recommendation
1. <i>Hardhat w/chin strap</i>	Each person			Altenbach (1995)
2. <i>Light - Three sources, MSHA-approved</i>	Each person			Altenbach (1995)
3. <i>Gas Detector - combination O₂, CO and Combustible Gas (LEL)</i> Separate H ₂ S detector	1 1	National Mine Service (TMX 412) " (T80 Instrument) R. McCulloch has 1 O ₂ detector and 1 flame safety lamp	\$1,450.00 \$495.00	Altenbach (1995), Diamond Hill Mine Rescue Team, Montana Mining Association Safety Coordinator.
4. <i>O₂ detector with a remote sensor head.</i> Remote sampling pump attaches to detectors.	1	National Mine Service	\$398.00	Altenbach (1995)
5. <i>Oxygen-Generating Self Rescuer</i>	Each Person	National Mine Service (Oxy K-plus)	\$473.00	Altenbach (1995), Diamond Hill Mine Rescue Team, Montana Mining Association Safety Coordinator.
Additional:				
6. Radon dosimeter	Each Person	National Mine Service Model Q300 Q250	\$1695.00 \$1250.00	R. McCulloch (MT BM&G)
7. <i>Respirator w/filters for particulates and ammonia (for areas with potential Hantavirus- contaminated rodents).</i>	Each Person	National Mine Service	\$ 21.38 (1/2 mask) \$ 27.54 (6 ammonia filters)	Altenbach (1995)
8. Steel-tipped rubber boots at least 18" high	Each Person	National Mine Service (only 16" & 17")	\$50.00 - \$60.00	Diamond Hill Mine Rescue Team, R. McCulloch (MT BM&G)
9. Safety glasses w/side shield	Each Person			Diamond Hill Mine Rescue Team, Montana Mining Association Safety Coordinator.
10. Gloves	Each Person			Diamond Hill Mine Rescue Team
11. Mine Belt	Each Person			
12. Roofer's kneepads	Each Person			
13. Poke Stick - test for loose rock (4' long) (also called a scaling bar)	1			Diamond Hill Mine Rescue Team, Montana Mining Association Safety Coordinator.,.

Table 2 (cont.)

EQUIPMENT	Number needed	Availability??	Per Unit Cost*	Source of Recommendation
14. 20 ft. aluminum ladder	1	Rock Hand Hardware (extension ladder)	\$77.99	R. McCulloch (MT BM&G)
15. Fin hoe (shovel with blade perpendicular to handle)	1			
16. Surveyor's string tape (Hip-Chain) -- for Distance measuring.	1 plus replacement line (2,740 m ea.)	Forestry Supply	\$115.00 \$4.70	R. McCulloch (MT BM&G)
17. Slicker -- rubberized bibs (protect skin)	Each Person	Forestry Supply	\$28.00	R. McCulloch (MT BM&G)
18. Climbing Ropes (7/16", static)	2-50 m & 1-100 m (600' roll)	Bob & Bob (Bluewater 2-plus) (1-800-262-2283)	\$390.00	D. Kampwerth (BLM), R. McCulloch (MT BM&G)
19. First Aid Kit	1	Forestry Supply	\$22.75 - \$46.95	R. McCulloch (MT BM&G), D. Kampwerth (BLM)
20. Rabies Vaccination	Each Person (3 doses required)	Lewis & Clark County Health Dept.	\$72.00 per dose (i.e., \$216/vaccination)	R. McCulloch (MT BM&G)
21. Communication device -- Cellular Phone (communicate from mine site for assistance in necessary)	1	CommNet Cellular, Helena (State Govt. Rate)	\$29.99/mo. plus \$40.00 one-time activation fee	Diamond Hill Mine Rescue Team, R. McCulloch, D. Kampwerth
22. Short-handled shovel	1			
Temperature/Humidity Recorders				
Oakton Thermohygrometer (accuracy, +/- 0.5° C, +/- 2% RH)	1	Forestry Supply	\$ 335.00	
Oakton Digital Thermohygrometer (accuracy, +/- 1° C, +/- 5% RH)	1	Forestry Supply	\$ 49.00	
Taylor Pocket Case Thermometers	1	Forestry Supply	\$9.95 - 27.35	
Air Flow				
Pocket wind meter	1	Forestry Supply	\$95.00 - \$123.00	
Smoke Tubes (to identify a static flow)		Haven't located yet	??	

EQUIPMENT	Number needed	Availability??	Per Unit Cost*	Source of Recommendation
DATA LOGGERS				
HOBO Waterproof Temperature units			\$69.00	
Humidity units			\$140.00 to 220.00	
Software			\$59.00	

* There may be opportunities to lease or buy used the more expensive equipment.

Equipment Vendors

Northwest Mine Supply (Sales) (Rental?) 1-800-456-1164
 National Mine Service (Sales) (Rental?) 1-800-996-6672
 MAS (Mine Safety Appliances Company) Sales & Rental 1-800-332-0435
 Oilind Safety - Rental only (sending catalog) 1-800-843-4855
 Arizona Mine Service Co. 1-602-968-1910
 Geological Supply (sending catalog) 1-800-247-6853

Data Logger Manufacturer

ONSET Computer Corporation 1-508-759-9500
 (www.onsetcomp.com)

Temperature, Humidity, Air Flow

Forestry Supply 1-800-647-5368